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Recommended Citation
Melvin II, Paul D. and Sharma, Subhash C., "Efficiency Analysis of K-12 Public Education in Illinois" (2007). *Discussion Papers*. Paper 62.
http://opensiuc.lib.siu.edu/econ_dp/62

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Efficiency Analysis of K-12 Public Education in Illinois

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Abstract

The public education system in the United States has received a great deal of attention from both constituents and policy makers alike over the past thirty years. Identifying less efficient school districts and examining the sources of inefficiency has important policy implications. School districts might improve efficiency by managing educational resources differently. In this paper, we estimate technical efficiency for all three types of school districts in the state of Illinois K-12 public education system. Technical efficiency in the Illinois school system averaged 90% for unit school districts, 85% for elementary school districts, and 82% for high school districts. We also investigate possible factors associated with inefficiency. The percentage of student enrollment that qualifies as low income and the size of the school district are positively related to inefficiency. School districts that have a larger percentage of teachers with advanced degrees are more efficient. Having a lower ratio of students per administrator in a school district increases technical efficiency.

Keywords: Efficiency, Input Output Analysis, Productivity, Resource Allocation

1. Introduction

Over the past several decades, public education in the United States has received a great deal of attention from both constituents and policy makers. Investment in education represents a significant component of government spending. Total taxpayer investment in K-12 education for the 2004-05 school year in the United States was 536 billion dollars. With per student expenditure greater than 8000 dollars per annum, the United States is a world leader in education investment. Although nominal per student spending by the federal government has doubled in the past 30 years, test scores have seen no significant improvement (Lips, 2004). The Third International Math and Science Study (1995), which tested grade 12 students, ranked the United States 19 of 21 countries

Under the Unites States constitution, responsibility for K-12 education lies with the states. Federal support began in 1965 with the enactment of the Elementary and Secondary Education Act (ESEA). A reauthorization of ESEA occurred in 2001 with the enactment of the "No Child Left Behind Act", (NCLB). The expressed purpose of NCLB is to raise the achievement of all students and lessen the achievement gap (U.S. Department of Education, 2006). This is to be accomplished through accountability, research based instruction, and flexibility and options for parents.

While federal financial support is considerable in terms of elementary-secondary education, the bulk of revenues come from state and local sources. The education budget for elementary and secondary education in Illinois for the 2004-05 academic year was over 20 billion dollars, 10% came from federal funds, 34% from state funds, and 56 % from local tax revenue. States are responsible for the allocation of resources and are accountable for achieving the standards mandated by NCLB. Efficient employment of resources is a significant issue

concerning the public education system within the states. Elementary-secondary per student expenditure in the United States averaged 8,297 dollars in the 2003-04 school year. New Jersey topped the range at 12,981 dollars while Utah, at 5,008 dollars, was at the bottom. Per student spending in Illinois is close to the mean at 8,657 dollars. This paper is motivated by the question: Can we attribute inadequate standardized scores of students to the inefficient use of education resources?

While the relationship between school expenditures and student achievement has received a great deal of attention, opinions concerning this association remain varied. Systematic efforts to identify this relationship reached public awareness with a study by Coleman (1966) entitled "Equality of Education Opportunity". Coleman found that school resources had surprisingly little impact on achievement. Much of the work in the ensuing 40 years has followed the same methodology by attempting to investigate the relation between resources and achievement while controlling for background characteristics of students using regression analysis. Greenwald, Hedges, and Laine (1996) assembled a set of 60 such research studies and applied meta analysis to determine the direction and magnitude of the relationship between a variety of education inputs and student achievement. Their findings suggested that there is a relationship between these inputs and student performance. Hanushek (1981, 1986, 1989, 1991) on the other hand, has studied the education production function literature extensively and determined that there is no evidence provided by the data that a strong or consistent relationship between resources and student achievement exists. Another approach to analyzing education productivity is to estimate school efficiency and investigate the factors associated with efficiency. Efficiency can be estimated using either Data Envelope Analysis (DEA) or Stochastic Frontier Analysis (SFA). Fare, Grosskopf, and Weber (1989) used DEA to

measure performance among Missouri school districts. Grosskopf, Hayes, Taylor, and Weber (1999) employ DEA to analyze the possible benefits of school reform in Texas. Grosskopf and Moutray (2001) used DEA to evaluate performance of Chicago school districts after decentralization. Recent work by Chakraborty, Biswas, and Lewis (2001) compared nonparametric and parametric approaches in defining the education production frontier and measuring the efficiency of Utah school districts. Their work concluded that there is very little difference between the Data Envelope Analysis (DEA) and Stochastic Frontier Analysis (SFA) when ranking school districts in terms of efficiency. Identifying less efficient districts and exposing the sources of inefficiency has important policy implications in that school districts might improve efficiency by managing controllable inputs differently.

In this paper, SFA is used to estimate the education production frontier for the state of Illinois, K-12 public education system. Illinois is chosen because it represents a reasonable reflection of the United States as a whole. It is near the mean in terms of per pupil expenditures, represents a good mix of rural and urban schools, and embodies a wide diversity of culture driven characteristics. First, each school district is ranked in terms of efficiency. Then, suspected sources of inefficiency are investigated to determine their effect on student performance.

Koopman (1951) defines technical efficiency *(TE)* as a feasible input output vector where it is technically impossible to increase any output (or reduce any input) without simultaneously reducing another output (or increasing another input). The production frontier describes the technical relationship between the input and output of a production process. It defines the maximum outputs attainable from a given set of inputs. School districts operate on that frontier if they are technically efficient, or beneath the frontier if they are not technically inefficient.

A school district that is technically efficient may still be able to improve its productivity (measured as the ratio of output to inputs) by exploiting scale economies *(SC)*. The nature of school districts makes it difficult to alter scale of production. Districts are formed to serve a defined area and enrollment changes are dictated by eligible student population. Formation of a new district or mergers of existing ones would be difficult to achieve quickly, therefore *(SC)* can be given a long-term interpretation while *(TE)* can be thought of as a short term phenomenon.

When comparisons of productivity across time are considered, it is possible to encounter another source of productivity change described as technological progress. Technological progress *(TP)* can be defined as a shift in the education production frontier. An upward shift in the frontier may represent advances in technology. If it is observed that a school district has increased its productivity from one time period to the next, the improvement need not have been from efficiency improvements alone, but may have been due to technological progress, exploitation of scale economies, or from some combination of these factors (Coelli, Rao, and Weber, 1998).

Methods for estimating efficiency have evolved along two distinct approaches; parametric and nonparametric. Data Envelope Analysis (DEA) is a non-parametric approach that uses mathematical programming to measure efficiency. One serious disadvantage of this approach is that it is deterministic, so that a non-stochastic environment is assumed. Given the presence of random shocks that can affect output performance, the use of a deterministic methodology is not warranted (Sharma, Sylwester and Margono, 2007). Stochastic Frontier Analysis (SFA) on the other hand, is a parametric approach that uses econometric techniques to estimate efficiency. SFA requires the specification of a functional form that characterizes the

technology of production but this approach permits random error that is beyond control of the management[1].

Empirical application of the SFA approach to estimating efficiency is prevalent in studies across many sectors. Aigner et al. (1977) first introduced efficiency analysis of the agriculture sector. Recent applications of SFA to the agriculture sector include; Liu and Zhong (2000), and Amaza and Olayemi (2002) among others. There have been many efficiency studies of the U.S. banking industry for example, Berger and Deyoug (2001), and Akhigbe and McNulty (2003). SFA has been widely applied to the manufacturing sector as well i.e. Mahadeven (2000), Zhang and Zhang (2001), Kaynak and Pagan (2003), and Heru and Sharma (2006).

The frontier production function defines the maximum output achievable under the current technology given the available factors of production. Productivity variations among school districts can rise from different sources including *SC*, *TP* and other exogenous sources, as well as, differences in *TE*. The use of panel data is superior to simple cross sectional data in that it is better to study efficiency over multiple periods rather than in a single period. Any particular school district is susceptible to abnormal performance in a single year. Thus, studying efficiency over several years will provide a more accurate picture of efficiency of school districts.

2. Methodology

To obtain the estimate of *TE*, it is necessary to define the functional form $f(x_{it}, t, \beta)$ prior to estimation. The translog production function developed by Christiansen, Jorgensen and Lau (1973) is the most prevalent functional form used in the SFA literature for a number of reasons. First, it provides some degree of generality as it is a second order approximation to an arbitrary

[1] Comprehensive reviews of these two approaches can be found in Coelli, Rao and Battese (1998) and Kumbhakar and Lovell (2000).

functional form. Other familiar functional forms such as the Cobb Douglas and CES are special cases of the translog function so these common forms are encompassed by the translog production function. Second, the translog function allows for varying returns to scale and for technological progress to be both neutral and factor augmenting. Additionally, partial elasticities of substitution are allowed to vary and elasticity of scale can vary with output and input proportions (Sharma, Sylwester, and Margono, 2005). The time varying translog production function of school district *i* at time *t* can be specified as in (1):

$$\begin{aligned} \ln y_{it} = \beta_0 + \sum_j \beta_j \ln x_{j,it} + \beta_i t + \frac{1}{2}\sum_j \sum_k \beta_{jk} \ln x_{j,it} \ln x_{k,it} \\ + \frac{1}{2}\beta_{it} t^2 + \sum_j \beta_{jt} \ln x_{j,it} + v_{it} - u_{it} \end{aligned} \tag{1}$$

where $i = 1,2,\cdots N, t = 1,2,\cdots T, jk = 1,2,\cdots K$, *N* is the number of school districts included in the analysis, *T* is the number of time periods in the data series, and *K* is the number of inputs considered. In this study, the output from each school district is the percentage of students that meet or exceed minimum standards as defined by the state of Illinois. Inputs to the education production function for each district include the per student operating expenditure, the ratio of teachers to students, and per student equalized assessed value of property encompassed by the district. The v_{it} term in the production function (1) represents a random component that is beyond the control of management and u_{it} (1) is an inefficiency component that includes variables suspected of having a connection to inefficiency. Equation (2) represents an expression for the inefficiency component:

$$u_{it} = \delta_0 + \sum_h \delta_h z_{h,it} \qquad (2)$$

where $h = 1,2 \cdots H$ is the number of factors considered to be associated with inefficiency. In this study, variables depicting parental involvement, teacher characteristics, and district characteristics are among those considered as factors associated with inefficiency in school districts. Following the panel data model introduced by Battese and Coelli (1995), maximum likelihood method is used to simultaneously estimate the translog production frontier that is given by (1) and the inefficiency components given by (2).

3. Data

The Illinois State Board of Education (ISBE) is the principal source of educational statistics in Illinois. Data for this study is obtained from the Illinois School Report Card (ISRC) published annually by the ISBE in compliance with The Better Schools Accountability Law. The ISRC provides school accountability information to the public via several online formats. Included are data on student demographics, district staffing, finance, and state assessment. Consistent data for 871 Illinois school districts is available from 2002 through 2005 comprising a panel data set containing 3848 observations that is considered here. School districts are divided into three distinct types: unit school districts (USD) that are comprised of both elementary and secondary schools; high school districts (HSD) that encompass only secondary schools; and elementary school districts (ESD) that contain only grade schools. It is unreasonable to assume that a direct comparison of efficiency between these different types of school districts is appropriate. For this reason, this data is divided into three subsets corresponding to the type of district.

The USD subset includes 394 districts and contains a total of 1576 observations. There are 376 districts included in the ESD subset and 101 districts that make up the HSD subset. The ESD and HSD subsets are comprised of 1504 and 404 observations respectively. Education production functions for each type of school district are estimated so that districts can be ranked, in terms of efficiency, among peer districts.

Output from the education process is percentage of students from the school district that meet or exceed standards established by the State Board of Education pursuant to Section 2-3.25a and No Child Left Behind legislation. Meet or exceeds refers to the distribution of students in the various performance levels based on their Grade 2 assessment, ISAT, PSAE, IMAGE, or IAA scores. Performance levels are defined in the school report cards. Illinois Grade 2 Assessment is a test in reading and mathematics administered in title 1 funded schools to comply with federal law. Illinois Standard Achievement Test (ISAT) is administered in reading and mathematics in grades 3 through 8 and science in grades 4 and 7. The Prairie State Achievement Examination (PSAE) measures performance of grade 11 students in reading, writing, mathematics, science, and social science. Illinois Measurement of Annual Growth in English (IMAGE) measures the progress of students with limited English proficiency in attaining English-language reading skills. Illinois Alternate Assessment (IAA) is administered to students with significant cognitive disabilities whose Individualized Education Programs indicate that participation in the ISAT or PSAE are not appropriate.

Inputs into the education production function include per student operating expenditure, the teacher to student ratio, and per student assessed property value. Operating expenditures is the dollar amount spent per student within the school district. Teacher to student ratio is the number of certified classroom staff employed per 100 students for each school district. Assessed

property value is the equalized assessed value of the property encompassed by the school district[2]. Property value assessment is an indicator of how much capital is available for education within each district.

The average school district in Illinois has 2327 students enrolled, employs 143 teachers, and spends 8170 dollars per student. It is also observed that on average across the data set that just under 68% of the students enrolled in a school district will meet or exceed the standards prescribed by the State.

In addition to the input resources employed by each school district, there are factors specific to the district that may be associated with inefficiency. A number of candidates are included as possible factors associated with inefficiency in this study:

- Percentage of low income students is considered as a factor associated with inefficiency. Low income students are from families receiving public aid, living in institutions for neglected or delinquent children, being supported in foster homes with public funds, or eligible to receive free or reduced price lunches. This variable can be interpreted as an indication of the quality of the environment a student is exposed to outside of school. It may also be an indicator of the education level of the student's guardians.
- Parental involvement is another factor we consider as being associated with inefficiency. It is the percentage of students whose parents or guardians had one or more personal contacts with the students' teachers during the school year concerning the education of the student. Each student is counted only once even if parents made more than one

[2] Data expressed in dollars has been deflated to constant 2002 prices using the CPI for the Midwest from the U.S. Bureau of Labor Statistics.

contact with teachers during the school year. Parental involvement is an important concern as evidenced by encouraged involvement in PTA.

- Percentage of male teachers employed by a school district is also included as a factor. Arguments have been made that having a male teacher can have a positive influence for students that are in need of male role models.
- Percentage of teachers employed that have an advanced degree. Incentives are often provided for teachers to obtain higher degrees. Teachers with Master's degrees could be related to higher efficiency in the education process.
- The size of a school district may impact how efficient resources are employed. Larger districts require a greater degree of administration and may suffer from bureaucratic congestion that can be found in large public institutions. Illinois school districts are characterized as either small, medium, or large. We include school district size as a factor associated with inefficiency.
- Teaching experience is considered as a factor associated with inefficiency. It is the average number of years teachers in the school district have been teaching.
- Student to administrator ratio can give an indication of the management structure of a school district and may be a measure of the degree of bureaucracy within the district. Are school districts that are top heavy with management less efficient?

4. Model and Estimation Results

4.1 Model to be estimated

Following Battese and Coelli (1995), maximum likelihood estimation is used to simultaneously estimate the parameters of stochastic production frontier (3) and the factors contributing to inefficiency (4). The software program FRONTIER 4.1C is used to perform estimation.[3]

Inputs to the education production function include per student operating expense (*E*), teacher to student ratio (*R*) and assessed property value per student (*X*). To capture technological change, the production function is allowed to vary over time, therefore a time trend (*t*) is included as well. Therefore, the translog specification of (1) estimated is:

$$\begin{aligned}\ln Y_{it} = {} & \beta_0 + \beta_1 \ln E_{it} + \beta_2 \ln R_{it} + \beta_3 \ln X_{it} + \beta_4 t \\ & + 0.5\left[\beta_5 (\ln E_{it})^2 + \beta_6 (\ln R_{it})^2 + \beta_7 (\ln X_{it})^2 + \beta_8 t^2\right] \\ & + \beta_9 \ln E_{it} \ln R_{it} + \beta_{10} \ln E_{it} \ln X_{it} + \beta_{11} t \ln E_{it} \\ & + \beta_{12} \ln R_{it} \ln X_{it} + \beta_{13} t \ln R_{it} + \beta_{14} t \ln X_{it} + v_{it} - u_{it}\end{aligned} \tag{3}$$

where v_{it} is random error and u_{it} is the inefficiency term. The specification of u_{it} is given by equation (4):

[3] The authors would like to thank Professor Tim Coelli for making the Frontier 4.1C software program available to us.

$$u_{it} = \delta_0 + \delta_1 LI_{it} + \delta_2 PI_{it} + \delta_3 MT_{it} + \delta_4 MD_{it} + \delta_5 DS_{it} + \delta_6 RE_{it} + \delta_7 SA_{it} + \eta_{it} \qquad (4)$$

where *LI* is the percentage of low income students, *PI* is parental involvement, *MT* is percentage of male teachers, *MD* is the percentage of teachers who hold a Master's degree, *DS* is the district size, *RE* is teacher experience, *SA* is the student to administrator ratio, and η_{it} is a random error term.

Output elasticities are given by:

$$e_{E_{it}} = \frac{\partial \ln Y_{it}}{\partial \ln E_{it}} = \beta_1 + \beta_5 \ln E_{it} + \beta_9 \ln R_{it} + \beta_{10} \ln X_{it} + \beta_{11} t \qquad (5)$$

$$e_{R_{it}} = \frac{\partial \ln Y_{it}}{\partial \ln R_{it}} = \beta_2 + \beta_6 \ln R_{it} + \beta_9 \ln E_{it} + \beta_{12} \ln X_{it} + \beta_{13} t \qquad (6)$$

$$e_{X_{it}} = \frac{\partial \ln Y_{it}}{\partial \ln E_{it}} = \beta_3 + \beta_7 \ln X_{it} + \beta_{10} \ln E_{it} + \beta_{12} \ln R_{it} + \beta_{14} t \qquad (7)$$

4.2 Estimation results

4.2.1 Efficiency

The model depicted by equations (3) and (4) is estimated using the MLE method for each of the three types of school districts, USD, ESD, and HSD, in Illinois. Initial parameter estimates for the translog education production frontier depicted by these equations is presented for each type of school district in Table 1.[4] The null hypothesis that β_5 through β_{14} are all equal to zero is rejected at conventional significance levels with chi-square statistics of 394.6, 546.9, and 155.68 for USD, ESD, and HSD respectively, so we find that the translog is preferred to the Cobb-

[4] Technical efficiency for individual school districts in each year of the study is available from the authors.

Douglass functional form in all three cases. γ denotes the variance from the inefficiency component of the error term divided by the total variance. The likelihood ratio test for the null hypothesis that $\gamma = 0$ and $\delta_0 = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = 0$= 0 is 1133.7 for USD, 833.6 for ESD, and 110.7 for HSD with 9 degrees of freedom. In the event this null hypothesis had not been rejected, it would indicate that none of the school district characteristics matter for inefficiency and the model could be consistently estimated using ordinary least squares.

The coefficient for operating expense per student is significant at the 5% level in USD, ESD and HSD. The student to teacher ratio coefficient is significant in across all three types of school districts as well and is negative for USD and HSD. The coefficient for assessed property value per student is significant in USD, it is negative in both ESD and HSD. The coefficient of the time trend is significant only in ESD and is positive. A positive time trend would indicate the presence of technological progress. The second order term of the time trend indicates the direction and acceleration of technological progress with respect to time. From the positive coefficient associated with the time trend second order term in ESD, it would appear that technological progress with respect to time has been increasing in ESD over the period from 2002 through 2005. It is surprising that some input coefficients display a negative sign. However, accurately determining the effect of a change in education output due to a change in input resources requires the evaluation of the output elasticity for each education input resource.

Mean technical efficiency for unit school districts in Illinois over the period from 2002 to 2005 is estimated to be 90%. These results are comparable to a study by Chakraborty, Biswas, and Lewis (2001) which report that technical efficiency among Utah school districts is between 86% and 90%. Overall, average annual efficiency of USD in Illinois has remained fairly constant over time. Average technical efficiency among USD ranges from 44% to 98%. The

gap between the most and least efficient has narrowed only slightly during this period. In 2002, the percentage point gap was 54% and in 2005 it fell to 50% indicating that the least efficient USD have improved relative to the most efficient. Increasing technical efficiency indicates that unit school districts have moved closer to the education production frontier. Table 2 presents the estimated technical efficiency for each USD. Districts are ranked in terms of average technical efficiency and divided into quartiles based on efficiency. Among USD, 25% exhibit average technical efficiency higher than 94.61%, the median efficiency is 92.24%, and 75% of USD are above 88.13% efficient.

Lexington unit school district has the highest technical efficiency at 98.16% while Madison unit school district is the least efficient at 43.77%. Lexington district enrolls a comparatively small percentage of low income students at 12% compared to the USD average of 29%. On the other hand, 91% of the students enrolled at Madison fall into the low income category. Teacher experience at Madison school district at 17 years is above the USD average of 15 years while teacher experience at Lexington is just below the average at 14 years. The property tax base encompassed by Lexington is among the highest in the state at just over 100,000 dollars per student and ranks 99th out of 394 USD. Madison school district on the other hand, has an estimated property valuation per student that is just under 28,000 dollars per student, putting it at 383rd of 394.

Mean technical efficiency for elementary school districts in Illinois over the period from 2002 to 2005 is estimated to be 85%. Average annual efficiency in ESD has increased slightly over this period. In 2002, average efficiency among all elementary school districts was 84% by 2005 average efficiency had increased to 86%. Table 3 reports the estimated average technical efficiency for each ESD. Elementary school districts are ranked based on their mean technical

efficiency and divided into quartiles. The fourth quartile among ESD is 93.85%, median efficiency is 88.57%, and the first quartile is 80.34%.

The most efficient ESD is Western Springs at 97.81% and the least efficient is General George Patton Elementary at 41.77%. The gap between the most and least efficient ESD has narrowed slightly throughout this period from 66.94 to 62.17 percentage points. General Patton at 21% is below the ESD average of 37% in terms of teachers with advanced degrees and ranks 279th of 376. Western Springs is above average with 44% of its teaching staff having advanced degrees. Average property value per student in ESD is 194,000 dollars. Average assessed property value per student in General Patton district is well below average at 85,000 dollars. Western Springs district at 5% has a very small percentage of students that qualify as low income and ranks 367th of 376. General George Patton at 42% ranks 36th of 376 in terms of low income students enrolled.

Mean technical efficiency for high school districts in Illinois over the period from 2002 to 2005 is estimated to be 82%. Average annual efficiency of HSD has remained constant between time periods. Adlai Stevenson High is the most efficient district at 96.10% and the least efficient is Proviso Township High at 33.03%. The gap between districts reporting the highest technical efficiency and the lowest has remained consistently around 63 percentage points across the study period. Table 4 displays the estimated efficiency for each high school district in Illinois for each year of study. HSD are ranked based on efficiency estimates and divided into quartiles. The third quartile is 90.98%, the second and first quartiles are 85.58% and 78.09% respectively. Adlai Stevenson district has the lowest percentage of low income students among all HSD. In contrast, Proviso Township district is in among the highest in terms of low income students at 25% and ranks at 26 of 101 HSD.

4.2.2 Factors Contributing to Inefficiency

Among the three types of school districts, USD display greater technical efficiency than either ESD or HSD. This seems rather peculiar since USD contains both elementary and high schools which are separately less efficient. One plausible explanation is that unit school districts are able to capitalize on synergies that are not available to districts containing only elementary or only secondary students. For example, unit schools may be able to shift resources more effectively between classes of students. Additionally, having the entire K-12 curriculum under one administration, as in USD, may benefit student's preparation as they advance to higher grade levels.

Our estimation procedure also attempts to identify several district specific characteristics associated with inefficiency. A positive coefficient indicates a positive relationship with inefficiency. As observed in Table 1, most of the δ coefficients are significant at the 5% level. The coefficient for low income is positive for all three types of school districts indicating a positive relationship with inefficiency. School districts with a larger percentage of their students classified as low income are less efficient. The magnitude of the coefficients reveals that having a larger enrollment of low income students impacts efficiency more in ESD than USD or HSD. Parental involvement is associated with higher efficiency in UDS, ESD and HSD. The sign of the coefficient for parental involvement is significant and negative across all type of districts. Parental involvement improves efficiency most greatly in ESD.

The percentage of male teachers is significant at the 5% level for both USD and ESD but not for HSD. Percentage of male teachers is positively associated with inefficiency in ESD but negatively associated with inefficiency in USD and HSD. Elementary school districts with a

larger percentage of male teachers are less efficient. Having a larger percentage of teachers with master degrees is associated with higher efficiency among all three types of school districts. The relationship between school district size and inefficiency is significant at the 5% level and positive for all three types of school districts. Larger school districts are less efficient than smaller school districts.

Teacher experience is significant at the 5% level for both USD and ESD but not HSD. Teaching experience is negatively associated with inefficiency in ESD but positively associated with inefficiency in USD and HSD. Elementary school districts that employ more experienced teachers display greater technical efficiency while high schools with more experienced teachers are less efficient. Pupil to administrator ratio is negatively associated with inefficiency and is significant at the 5% level for all three types of school districts in Illinois. School districts that have more administration per pupil are more efficient. However, the magnitudes of these coefficients are very small. One interpretation of the administrator role is teacher supervision. Closer supervision of teachers may insure that students classroom needs are being addressed, resulting in improved efficiency in the education process.

Returns to scale is determined by summing the three elasticities e_E, e_R, and e_X. Adding the three together, we determine the returns to scale for all Illinois school districts is 0.2264, implying that there are decreasing returns to scale. This suggests the assumption of constant returns to scale is not appropriate for examining education production of school districts in Illinois.

Table 5 reports mean estimates for the output elasticities e_E, e_R, and e_X as calculated using equations (5), (6), and (7).[5] Average output elasticity of operating expense per student for

[5] Elasticities for all the individual school districts in each year are presented in the appendix.

all district types (e_E) is -0.122, elasticity of the teacher to student ratio (e_R) is 0.220, and elasticity for assessed property valuation (e_X) is 0.129. These elasticities measure the percentage change in output resulting from a one percent change in an input while all other inputs are held constant. Using this interpretation we expect that increasing the operating expenditure per student by one percent, while holding everything else constant, would yield a -0.122 percent decrease in education output. A similar observation can be made in regards to the student teacher ratio, increasing the number of teachers will increase the percentage of students meeting or exceeding the standards ceteris paribus. The output elasticity for the assessed property value is positive suggesting that a one percent increase in the assessed value of the property encompassed by a school district would yield a 0.129% increase in education output.

5. Conclusion

This paper examines technical efficiency of the public school system in Illinois. Using Stochastic Frontier Analysis, we are able to estimate an education production frontier for three different types of school districts in the state. This approach facilitates evaluating individual school districts from a technical efficiency point of view and investigating factors associated with inefficiency.

A panel data set consisting of 871 school districts over a 4 year period from 2002 through 2005 is considered for the study. The data set is divided into three groups corresponding to the different school district types. Technical efficiency in the Illinois school system averaged 90% for unit school districts, 85% for elementary school districts, and 82% for high school districts. Efficiency of the public education system in Illinois has remained virtually constant for the 4 years included in this study. Individual districts are ranked by average efficiency. Lexington is

ranked as the most efficient unit school district at 98.16% and Madison is lowest at 43.77%. Western Springs at 97.81% is ranked as the most efficient elementary school district while General George Paton at 41.77% is the least efficient elementary school district. Adlai Stevenson displays the highest technical efficiency among high school districts at 96.10% and Proviso Township is lowest at 33.03%. The gap between the most and least efficient districts has not diminished significantly over the course of this study for either high school districts, unit school districts, or elementary school districts.

Investigation of the factors associated with inefficiency indicates that parental involvement, the percentage of teachers with advanced degrees and student to administrator ratio are negatively related to inefficiency. The percentage of students enrolled who qualify as low income and the size of the school district are positively related to inefficiency. Parental involvement has the largest impact on efficiency in elementary school districts. Percentage of male teachers is negatively related to inefficiency among unit school districts and high school districts but is positively related to inefficiency in elementary school districts. Teacher experience is negatively related to inefficiency in elementary school districts but is positively related to inefficiency in both unit and high school districts. Based on this information, an argument can be made that an emphasis on reducing the ratio of pupils to administrative staff or employing more male elementary school teaches is not warranted. We also provide evidence to mitigate the argument for smaller school districts and incentives for teachers to obtain advanced degrees.

Enrollment in Illinois public schools averaged 2,027,270 in each year across this study. 67.96% or 1,377,819 of these students on average meet or exceed standards as defined by the Illinois legislature. Average technical efficiency across all types of school districts is determined

to be 85.67%. To put into perspective the impact of a change in efficiency, consider an improvement to 90% efficient. This would translate to an additional 87,000 students exceeding the standards each year without increasing inputs. Under this scenario, just over 72% of students enrolled in Illinois public schools would meet or exceed benchmark standards as defined by the state. It is apparent that technical efficiency improvements are a creditable pursuit for school system administrators. Elementary school districts and high school districts present the greatest opportunity for improvements in technical efficiency.

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Table 1:
Coefficients of Translog Production Function and Efficiency Components

Parameter		Estimate USD	ESD	HSD
β_0	(intercept)	7.79067*	4.44225*	9.14763*
β_1	(lnE)	-1.53773*	-0.43824*	-3.18856*
β_2	(lnR)	-1.80233*	0.19348*	-1.33815*
β_3	(lnX)	-0.14955*	0.00396	-0.14252
β_4	t	0.05000	0.07392*	0.14620
β_5	$.5(\ln E)^2$	-0.01387	0.03950	-0.17130
β_6	$.5(\ln T)^2$	0.01855	0.03782	0.12792
β_7	$.5(\ln X)^2$	-0.00144	-0.01950	-0.00735
β_8	$.5(t^2)$	0.00844	0.00826	0.01498
β_9	(lnE lnT)	0.53728*	-0.07212	0.76667*
β_{10}	(lnE lnX)	0.03839*	0.09849*	0.16488*
β_{11}	(lnE t)	0.02895	-0.03943*	-0.02692
β_{12}	(lnT lnX)	0.08617*	-0.01610	-0.02298
β_{13}	(lnT t)	-0.02849	0.01688	-0.00125
β_{14}	(lnX t)	-0.00425	-0.00506	-0.00862
Inefficiency components				
δ_0	(intercept)	0.53734*	-2.55140*	-0.61099
δ_1	(Low income %)	0.03767*	1.94631*	0.37192*
δ_2	(Parental involvement %)	-1.94045*	-0.44270*	-0.02803*
δ_3	(Male teachers %)	-0.90711*	2.79228*	-0.51005
δ_4	(Master's degree %)	-0.30363*	-3.14952*	-1.69286*
δ_5	(Size of district)	0.46976*	0.80839*	0.57840*
δ_6	(Teacher experience)	0.01593*	-0.13853*	0.01526
δ_7	(Pupil to Administrator)	-0.00362*	-0.00681*	-0.00179*
σ^2	(Variance of Inefficiency)	0.15661*	0.87798*	0.22252*
γ	$\sigma_u^2/(\sigma_u^2+\sigma_v^2)$	0.96940*	0.99679*	0.97322*

* Denotes significance at the 5% level

Table 2: USD Efficiency Estimates

Rank	District	Avg.	Rank	District	Avg.	Rank	District	Avg.
1	Lexington	0.979	50	Christopher	0.959	99	Marissa	0.946
2	Gibson City	0.979	51	Elmhurst	0.959		**3rd Quartile**	
3	Cissna Park	0.977	52	Pearl City	0.958	100	Pawnee	0.946
4	Tremont	0.975	53	Comm Unit	0.958	101	Sycamore	0.946
5	Brimfield	0.974	54	Columbia	0.958	102	Indian Prairie	0.945
6	West Wash.	0.973	55	Byron	0.958	103	Illinois Valley	0.945
7	Allendale	0.973	56	Ridgeview	0.957	104	Prairie Central	0.945
8	Mahomet	0.972	57	New Athens	0.956	105	Laharpe	0.945
9	Dunlap	0.972	58	Sullivan	0.956	106	Cons School	0.945
10	Wesclin	0.972	59	Morrison	0.956	107	Lowpoint	0.944
11	Dieterich	0.971	60	Midwest Cent.	0.955	108	Warrensburg	0.944
12	Lostant	0.970	61	Staunton	0.955	109	Bond Co	0.944
13	Mascouta	0.970	62	Chadwick Mill.	0.955	110	Cerro Gordo	0.944
14	Maroa Forsyth	0.970	63	Lake Zurich	0.955	111	Wauconda	0.943
15	Neponset	0.970	64	Beecher City	0.955	112	Yorkwood	0.943
16	Naperville	0.970	65	Delavan	0.955	113	Olympia	0.943
17	Barrington	0.969	66	Martinsville	0.954	114	Divernon	0.942
18	Teutopolis	0.969	67	Lisle	0.954	115	Northwestern	0.942
19	Geneva	0.969	68	Neoga	0.954	116	Triad	0.942
20	Tri Valley	0.969	69	Stewardson	0.954	117	Rosevill Alvin	0.942
21	Morton	0.968	70	Eastland	0.954	118	Effingham Comm	0.942
22	Valmyer	0.968	71	ROWVA	0.953	119	Riverdale	0.941
23	Mt Zion	0.968	72	Blue Ridge	0.953	120	Manteno	0.941
24	Carlinvill	0.967	73	Brussels	0.953	121	Bismark Henning	0.941
25	Elmwood	0.967	74	St Charles	0.953	122	Dixon	0.940
26	Roanoak	0.967	75	Central Comm	0.953	123	Comm Unit	0.940
27	Deer Creek	0.967	76	Triopa	0.952	124	Amboy	0.940
28	Macomb	0.967	77	Thompson	0.952	125	Jonesboro	0.940
29	Batavia	0.967	78	Grrenview	0.952	126	Herscher	0.940
30	Annawan	0.966	79	Orangeville	0.952	127	Highland	0.940
31	Williamsville	0.966	80	Tuscola	0.952	128	Porta	0.940
32	Orion	0.966	81	Flanagan	0.952	129	Polo	0.939
33	Forrestville Val.	0.964	82	Stockton	0.952	130	Comm Unit	0.939
34	Jamaica	0.963	83	Grayville	0.951	131	Iriquois Co	0.939
35	Waterloo	0.963	84	Oakland	0.951	132	Calhoun	0.939
36	Eureka	0.963	85	Waverly	0.951	133	Princeville	0.939
37	Wayne City	0.962	86	Pleasant Plains	0.950	134	Galena	0.938
38	Illini Bluffs	0.962	87	Fisher	0.950	135	Avon	0.938
39	Monticello	0.962	88	Donovan	0.950	136	Liberty	0.937
40	Beecher	0.961	89	Panhandle	0.950	137	Putnam	0.937
41	Carterville	0.961	90	Central A&M	0.949	138	Heritage	0.937
42	Geneseo	0.961	91	Hardin Co	0.949	139	Goreville	0.937
43	Indian Creek	0.960	92	Lena Winslow	0.948	140	Catlin	0.937
44	Meridian	0.959	93	Fieldcrest	0.948	141	Midland	0.937
45	Rochester	0.959	94	Dallas City	0.947	142	Steeleville	0.936
46	Johnsburg	0.959	95	Dakota	0.947	143	Mclean	0.936
47	Edwardsville	0.959	96	Mulberry Grove	0.947	144	Heyworth	0.936
48	Ball Chatham	0.959	97	Auburn	0.946	145	Harrisburg	0.936
49	Industry	0.959	98	Coulterville	0.946	146	Durand	0.936

Rank	District	Avg.
147	Bureau Valley	0.936
148	Kaneland	0.936
149	Cowden	0.936
150	Lebanon	0.936
151	Altamont	0.936
152	Tri City	0.936
153	Grant Park	0.936
154	Winnebago	0.935
155	Frankfort Com.	0.935
156	Alden Herbon	0.935
157	AC Central	0.934
158	Quincy	0.934
159	Cambridge	0.934
160	Galesburg	0.934
161	Mt Carroll	0.934
162	Wabash	0.934
163	Winsdor	0.934
164	Stark Co	0.933
165	St Elmo	0.933
166	Aurthur C	0.933
167	West Pike	0.932
168	Sesser Valier	0.932
169	Bradford	0.932
170	Oswego	0.932
171	Brownstown	0.931
172	Marshal	0.931
173	Hamilton Co	0.931
174	Bunker Hill	0.931
175	Edgar	0.931
176	Kansas	0.930
177	Yorkville	0.930
178	River Ridge	0.929
179	Deland Weldon	0.929
180	East Richland	0.928
181	Charleston	0.927
182	Waltonville	0.927
183	Farmington	0.927
184	Hinckley Big Rock	0.926
185	Paris	0.926
186	Aledo	0.925
187	Peotone	0.925
188	Matoon	0.924
189	Mt Pulaski	0.924
190	Rockridge	0.924
191	Bement	0.924
192	Johnson City	0.923
193	Roseville	0.923
194	Harstburg	0.923
195	DuQuoin	0.923
196	Somonauk	0.923
197	Leroy	0.923
	2nd Quartile	
198	Ashton-Franklin	0.922
199	Warsaw	0.922
200	East Dubuque	0.922
201	Atwood-Hammond	0.921
202	Westmont	0.921
203	South Fork	0.921
204	River Bend	0.921
205	North Clay	0.919
206	Wethersfield	0.918
207	Astoria	0.917
208	Sterling	0.917
209	Gallatin	0.917
210	Carmi-White	0.916
211	Elverado	0.916
212	West Richland	0.916
213	Meridian	0.916
214	Lovington	0.916
215	Tolono	0.915
216	Lawrence	0.915
217	Paris Union	0.915
218	Pleasanr Hill CU	0.915
219	Wareren Comm	0.915
220	Hamilton	0.915
221	Red Bud	0.914
222	Wnchester	0.914
223	Ramsey	0.914
224	Litchfield	0.914
225	Taylorville	0.913
226	Coal City	0.913
227	Abington	0.913
228	Franklin	0.912
229	Henry Senachwine	0.911
230	Earlville	0.911
231	Comm Unit	0.911
232	Sherrard	0.911
233	Edwards Co	0.910
234	Argenta	0.910
235	Woodstock	0.910
236	Clat City	0.909
237	Spoon River	0.908
238	Shiloh	0.908
239	Knoxville	0.908
240	Villa Grove	0.908
241	Erie Comm	0.908
242	Potomac	0.907
243	Shelbyville	0.906
244	Dupo	0.906
245	Griggsville	0.906
246	Mount Olive	0.906
247	Craborchard	0.905
248	Canton Union	0.904
249	Sothern	0.904
250	Pana	0.904
251	Carthage	0.903
252	Iriquois West	0.903
253	Athens	0.902
254	Woodland C U	0.902
255	Nokomis	0.902
256	Virden	0.901
257	Marquardt	0.900
258	Norris City	0.900
259	Carrier Mills	0.900
260	Galva	0.899
261	Comm Unit	0.899
262	Paw Paw	0.899
263	Payson	0.898
264	Wlimimgton	0.898
265	Murphysboro	0.898
266	Oregon	0.897
267	Tri Point	0.897
268	Zeigler	0.897
269	Greenfield	0.896
270	Peoria Heights	0.896
271	Schuyler	0.896
272	Jasper Co	0.895
273	Prophetstown	0.894
274	Galatia	0.894
275	Alwood	0.894
276	Paxton	0.894
277	Palestine	0.892
278	Joppa	0.892
279	Dekalb Comm	0.892
280	Havana	0.892
281	Bloomington	0.891
282	Granite City	0.891
283	Carrollton	0.890
284	Genoa	0.890
285	Pecatonica	0.888
286	Red Hill	0.888
287	Patoka	0.888
288	Gillespie	0.887
289	Leland	0.887
290	Bethal To	0.885
291	North Boone	0.885
292	Herrin	0.883

Rank	District	Avg.
293	VIT Comm	0.883
294	Robinson	0.882
295	Southeastern	0.882
	1st Quartile	
297	Vandalia	0.881
298	Moline	0.880
299	Marion	0.880
300	Girard	0.880
301	Southwestern	0.879
302	Flora	0.879
303	La Moille	0.879
304	Triad	0.878
305	Illini Central	0.877
306	Elmwood Park	0.876
307	Belvidere	0.875
308	Chester	0.875
309	Pikeland	0.875
310	Central CUSD	0.874
311	Hutsonville	0.874
312	Hillsboro	0.873
313	Carlyle	0.873
314	Jacksonville	0.873
315	Hoopeston	0.872
316	Momence	0.872
317	Clinton	0.871
318	Sparta	0.871
319	Shawnee	0.869
320	Plainfield	0.869
321	Westville	0.868
322	Roxana	0.868
323	Oakwood	0.866
324	Arcola	0.865
325	Reed Custer	0.865
326	Cumberland	0.864
327	Jersey	0.864
328	Nauvoo Colusa	0.859
329	Savanna	0.856
330	Massac	0.855
331	Scales	0.855
332	Bushnell Prairie	0.855
333	Monmouth	0.853
334	Matteson	0.850
335	Hiawatha	0.849
336	Brown County	0.848
337	Sandwich	0.848
338	Harlem	0.848
339	Pope Co	0.848
340	Riverton	0.846
341	Plano	0.845
342	Barry	0.842
343	Kewanee	0.842
344	Williamsfield	0.840
345	Cobden	0.835
346	Lewistown	0.832
347	Collinsville	0.830
348	Eldorado	0.829
349	Sandoval	0.829
350	Depue	0.826
351	Edinburg	0.820
352	Georgetown Ridge	0.817
353	South Beloit	0.817
354	Westmer	0.815
355	Casey Westfield	0.811
356	Morrisonville	0.810
357	South Central	0.809
358	Union Comm	0.808
359	Alton	0.808
360	Egypt5ian Comm	0.804
361	Central Comm	0.802
362	North Greene	0.801
363	Urbana	0.800
364	Crete Monee	0.799
365	Danville	0.796
366	Champaign	0.791
367	Dongola	0.790
368	Aurora West	0.790
369	Meredosia	0.781
370	Freeport	0.769
371	Harvard	0.763
372	Century	0.762
373	School Dist U	0.761
374	Virginia	0.757
375	Rock Island	0.748
376	Decater	0.743
377	Scott Morgan	0.739
378	Beardstown	0.734
379	Round Lake	0.723
380	Springfield	0.712
381	Peoria Sch	0.700
382	Cahokia	0.672
383	Rockford	0.669
384	Kankakee	0.660
385	Waukegan	0.652
386	Aurora East	0.636
387	Meridian C	0.632
388	North Cicago	0.604
389	Cairo	0.604
390	Brooklyn	0.542
391	East St Louis	0.541
392	Venice	0.516
393	City of Chicago	0.487
394	Madison	0.438

Table 3: ESD Efficiency Estimates

Rank	District	Avg.	Rank	District	Avg.	Rank	District	Avg.
1	Western Springs	0.978	48	Milburn	0.956	95	Prairie Grove	0.939
2	River Forest	0.977	49	Sunset Ridge	0.956		**3rd Quartile**	
3	Aviston	0.976	50	Limestone Walters	0.956	96	Robein	0.938
4	Giant City	0.976	51	Geff	0.956	97	Gardner Comm	0.936
5	Ewing	0.975	52	Kirby	0.956	98	Field	0.936
6	CC	0.975	53	Mount Prospect	0.955	99	Bluford	0.934
7	Unity Point	0.974	54	St Rose	0.955	100	Anna-C	0.934
8	Wilmete	0.974	55	Shiloh Village	0.955	101	Summersville	0.934
9	Rockton	0.974	56	Deerfield	0.955	102	Thorton Sch	0.934
10	Winnetka	0.973	57	Channahon	0.955	103	Lisbon	0.933
11	Kenilworth	0.972	58	Downers Grove	0.955	104	Comm Consolidated	0.933
12	Vienna	0.971	59	Riverside	0.955	105	Summit Hill	0.933
13	Jasper	0.971	60	Northbrook	0.955	106	North Wayne	0.932
14	Lincolnshire	0.971	61	Prospect Heights	0.954	107	Mokena	0.932
15	New Simpson Hill	0.970	62	Aptakisic	0.954	108	St George	0.932
16	Germantown Hills	0.970	63	Kinnikinnink	0.954	109	Rankin	0.932
17	Belleville	0.969	64	St Joseph	0.954	110	Creston	0.932
18	Signal Hill	0.969	65	Maercker	0.953	111	Deer Park	0.929
19	Benjamin	0.968	66	Mew Lenox	0.953	112	Roselle	0.929
20	Selmaville	0.968	67	Frankfort CC	0.953	113	East Peoria Sch	0.928
21	Arlington Heights	0.968	68	Woodlawn	0.952	114	Oak Park Elem	0.927
22	Kildeer	0.967	69	Breese	0.952	115	Medinah	0.927
23	Bartelso	0.967	70	Oak Grove	0.951	116	Raccoon	0.926
24	Prairieview	0.967	71	Darien	0.950	117	Desoto	0.926
25	Glen Ellyn	0.967	72	Palatine	0.949	118	Pleasantdale	0.924
26	Libertyville	0.966	73	Spring Lake	0.949	119	Skokie Sch Dist	0.924
27	La Grange Highland	0.965	74	Miller Twp	0.949	120	Riley	0.923
28	Cary	0.965	75	Avoca	0.949	121	Smithton	0.923
29	South Wilmington	0.965	76	Fox River Grove	0.948	122	Crystal Lake	0.923
30	Wolf Branch	0.965	77	La Grange	0.947	123	Opdyke	0.923
31	Glenco	0.965	78	Central SD	0.947	124	Homer	0.923
32	Freeburg CC	0.963	79	Cherry	0.946	125	Shirland	0.922
33	Germantown	0.962	80	Lake Bluff	0.944	126	Butler	0.921
34	Cass	0.962	81	Metamora	0.944	127	Tinley Park	0.920
35	Northbrook Glen.	0.961	82	Belle Valley	0.944	128	West Northfield	0.920
36	Washington Sch	0.961	83	Freemont	0.944	129	Malden	0.919
37	Palos	0.961	84	Tonica	0.944	130	Woodridge	0.918
38	Prairie Hill	0.961	85	Glenview	0.943	131	Lockport	0.918
39	Center Cass	0.959	86	Lemont Bromberek	0.942	132	Arbor Park	0.917
40	Nettle Creek	0.959	87	Palos Heights	0.942	133	Manhattan	0.917
41	Park Ridge	0.958	88	Bannockburn	0.942	134	Riverdale Sch	0.917
42	Gower	0.958	89	Lake Forest	0.941	135	Armstrong Ellis	0.917
43	Millstadt	0.958	90	Hampton	0.941	136	Itasca	0.917
44	Northbrook School	0.958	91	Hollis	0.940	137	Ladd	0.916
45	Orland	0.958	92	Comm Cons	0.940	138	Oak Lawn Hom.	0.915
46	Dalzell	0.958	93	St Libory	0.940	139	Bloomingdale	0.914
47	Ofallon	0.957	94	Homewood	0.939	140	Worth	0.914

Table 3 Continued

Rank	District	Avg.
141	Winthrop Harbor	0.913
142	Newark	0.912
143	Central school	0.912
144	Morton Grove	0.911
145	Bourbannais	0.910
146	N. Pekin	0.910
147	Minooka	0.908
148	Oak Grove Sch	0.907
149	Big Hollow	0.907
150	Ridgeland	0.907
151	Gurnee	0.907
152	Kings	0.906
153	Nippersink	0.905
154	Montmorency	0.905
155	North Shore	0.905
156	Monroe	0.905
157	Lincolnwood	0.904
158	Mundelein Elem	0.904
159	Fairview	0.903
160	Lombard	0.902
161	Shaumburg	0.902
162	Fairfield Public	0.901
163	Gran Prairie	0.901
164	Dodds	0.901
165	Northridge	0.898
166	Rosemont	0.898
167	Waltham	0.897
168	Hawthorn	0.897
169	Benton Comm	0.897
170	Dimmick	0.897
171	Willow	0.896
172	Woodland	0.895
173	Golf	0.894
174	Comm Cons	0.894
175	Dwight	0.894
176	Ashley C	0.893
177	St Anne	0.893
178	Troy	0.892
179	River Trails	0.890
180	Emmons	0.890
181	Niles	0.890
182	Union Ridge	0.889
183	Nashville	0.888
184	East Prairie	0.888
185	Wallace	0.887
186	West Lincoln	0.887
187	Grant Comm	0.887
	2nd Quartile	
188	Penoyer	0.886
189	Mazon Verona	0.885
190	Brookfield Lagrange	0.884
191	Morris	0.883
192	Pinckneyville Sch	0.882
193	Pontiac W Holiday	0.881
194	Albers	0.880
195	Cypress	0.879
196	Nelson	0.878
197	Bradley	0.878
198	Princton Elem	0.878
199	Ogden	0.878
200	Tamaroa	0.877
201	East Coloma	0.877
202	Central City	0.875
203	Queen Bee	0.873
204	Iuka	0.873
205	Eswood	0.873
206	High Mount	0.872
207	Saratoga	0.872
208	Milford	0.872
209	Skokie Sch	0.871
210	Creve Coeur	0.871
211	North Palos	0.870
212	Buncombe	0.869
213	Comm Cons	0.868
214	Flossmoor	0.867
215	Thompsonville Sch	0.867
216	Rome	0.866
217	Peru	0.863
218	Crescent City	0.862
219	Lake Villa	0.861
220	Streator	0.861
221	Cornell	0.861
222	Antioch	0.860
223	Pekin Public	0.860
224	South Pekin	0.860
225	Alsip-Hazlgrn-Oak.	0.859
226	Forest Ridge	0.858
227	Skokie	0.857
228	Mchenry C	0.853
229	Ina	0.850
230	Oakdale	0.850
231	Harmony	0.850
232	Prairie Du Rocher	0.849
233	Kell	0.849
234	Will Co	0.847
235	Lick Creek	0.847
236	Norwood	0.847
237	Marengo Union	0.847
238	Dupage County	0.846
239	Wood Dale	0.844
240	District 50	0.844
241	Gifford	0.842
242	McClellan	0.842
243	Comm Cons	0.841
244	Westchester	0.840
245	Farrington	0.835
246	Ogelsby	0.834
247	Steward	0.833
248	Rock Falls	0.833
249	Willow Springs	0.830
250	Eveergreen Park	0.830
251	Kmarek	0.829
252	Spring Vallry	0.829
253	Ottawa	0.829
254	Seneca Comm	0.829
255	Franklin Park	0.825
256	Centralia School	0.825
257	Silvis	0.825
258	Mendota	0.824
259	Grand Ridge	0.821
260	Gavin	0.821
261	Hoyleton	0.819
262	New Holland	0.818
263	Thomasboro	0.818
264	Bartonville	0.818
265	Salem	0.817
266	East Maine	0.816
267	Rockdale	0.816
268	Comm Cons	0.816
269	Rutland	0.814
270	Odin School	0.813
271	Rooks Creek	0.813
272	Rhodes	0.813
273	Odell	0.812
274	Lincoln Elem	0.810
275	Richland	0.810
276	Addison	0.808
277	River Grove	0.807
278	Evanston	0.806
279	Pontiac	0.806
280	Mount Vernon	0.805

Rank	District	Avg.
281	Fox Lake	0.804
	1st Quartile	
282	Keeneyville	0.804
283	Taft	0.802
284	Chester East	0.801
285	Communuty	0.798
286	Akin	0.796
287	Braceville	0.794
288	Salt Creek	0.793
289	La Gange South	0.792
290	Elwood	0.790
291	Atwood-Heights	0.790
292	Rochelle	0.790
293	Dianond Lake	0.787
294	Carbon Cliff	0.787
295	Wheeling	0.786
296	Oblong	0.780
297	Leepertown	0.776
298	Allen-Otter Creek	0.775
299	Marseilles	0.775
300	Damiansville	0.774
301	Pleasant Valley	0.774
302	Central Stickney	0.770
303	Rondout	0.767
304	Burbank	0.766
305	Logan	0.762
306	Grass Lake	0.760
307	Chicago Ridge	0.759
308	Berwyn South	0.756
309	Beach Park	0.754
310	Lyons	0.753
311	Harrison	0.751
312	Saunemin	0.750
313	North Wamac	0.747
314	Fulton City	0.747
315	Riverview	0.746
316	Rantoul	0.745
317	East Moline	0.740
318	Bensenville	0.739
319	Steger	0.739
320	Lansing	0.739
321	Park Forest	0.737
322	Indian Springs	0.734
323	Midlothan	0.732
324	West Chicago	0.731
325	La Salle Elem	0.730
326	Berwyn North	0.725
327	Comm Cons	0.724
328	Pleasant Hill Sch	0.721
329	Wood River	0.718
330	Bethel	0.718
331	Forest Park	0.718
332	Mannhem	0.717
333	East Alton	0.716
334	Ohio	0.711
335	Schiller	0.709
336	Colona	0.708
337	Elam	0.708
338	Carbondale El.	0.705
339	Chaney Monge	0.703
340	Cook County	0.697
341	South Holland	0.691
342	Irvington	0.690
343	Unoin Sch	0.684
344	Sunnybrook	0.670
345	Hillside	0.661
346	Brockwood	0.658
347	Summit	0.654
348	Laraway	0.652
349	Sandridge	0.642
350	Joliet Public	0.639
351	Pembroke	0.629
352	Berkeley	0.628
353	Country Club Hills	0.627
354	Posen Robbins	0.619
355	Zion	0.613
356	Lindop	0.607
357	South Holland Sch	0.604
358	Ludlow	0.587
359	Dolton	0.585
360	Ford Heights	0.582
361	Prairie Hill	0.573
362	Dolton	0.568
363	Hoover Schrum	0.564
364	Calumet City	0.547
365	Chicago Heights	0.545
366	Bellwood	0.544
367	Harvey	0.540
368	Lincoln Elem	0.540
369	Cicero	0.528
370	Maywood Melrose	0.511
371	Calumet Public	0.488
372	Hazel Crest	0.484
373	Fairmont	0.477
374	W Harvey	0.461
375	Burnham	0.454
376	Gen Goe Patton	0.418

Table 4: HSD Efficiency Estimates

Rank	District	Avg.
1	A. Stevenson	0.961
2	Riverside Brookfield	0.960
3	Ofallon Twp	0.959
4	Oak Park & River F.	0.958
5	Lake Forest Comm	0.957
6	Comm High	0.956
7	Hononegah	0.955
8	Nashville Comm	0.953
9	Homewood Flos.	0.946
10	Metamora Twp	0.944
11	Richmond Buurton	0.944
12	Gardner S Wilm.	0.942
13	Lake Park	0.938
14	Carbondale	0.938
15	Lyons Twp	0.938
16	Dwight Twp	0.933
17	Lockport Twp	0.929
18	New Trier	0.925
19	Township High	0.924
20	St Joseph Ogden	0.923
21	Hinsdale	0.922
22	Washington Comm	0.920
23	Lincoln Way	0.920
24	Freeburg HS	0.914
25	Comm HS	0.914
26	Mendota Twp	0.910
	3rd Quartile	
27	Princeton HS	0.909
28	Pontiac Twp	0.908
29	Grass Lake HS	0.906
30	Limestone	0.904
31	Northfield Twp	0.899
32	Evergreen Park HS	0.897
33	Comm HS	0.895
34	Bradley Burb.	0.886
35	Ohio HS	0.886
36	Minooka HS	0.884
37	Warren Twp	0.879
38	La Salle Peru	0.877
39	Glenbard Twp	0.876
40	Webber Twp	0.876
41	Pinckneyville HS	0.875
42	Vienns HS	0.875
43	Salem Comm	0.871
44	Belleville Twp	0.870
45	Cons HS	0.867
46	Lemont Twp	0.862
47	Oak Lawn	0.862
48	Marengo	0.859
49	Comm High	0.858
50	Newark HS	0.857
	2nd Quartile	
51	Mchemnry Comm	0.856
52	Mundelein	0.848
53	Armstrong Twp	0.845
54	Rochelle Twp	0.843
55	Rock Falls Twp	0.842
56	Woodlawn CHS	0.841
57	Benton Cons	0.838
58	Pekin	0.829
59	Fairfield HS	0.829
60	Mt Vernon Twp	0.829
61	Grant HS	0.826
62	Township HS	0.815
63	Lincoln Comm	0.814
64	Morris Comm	0.813
65	East Peoria Comm	0.810
66	Ridgewood	0.806
67	Anna-Jonsboro	0.806
68	Central Comm HS	0.805
69	Streator Twp	0.802
70	Ottawa HS	0.801
71	Milford Twp	0.799
72	Niles Twp	0.795
73	Township HS	0.792
74	Centralia HS	0.791
75	Comm HS	0.786
	1st Quartile	
76	Maine	0.781
77	Sneca Twp	0.777
78	Rantoul Twp	0.767
79	Dupage HS	0.765
80	Hall	0.751
81	Argo	0.727
82	Crescent Iriquis	0.719
83	Odin	0.719
84	East Alton WR	0.717
85	Zion Benton	0.711
86	Thorton Fractional	0.711
87	Fenton	0.705
88	Evanston Twp	0.701
89	Leyden	0.687
90	Comm HS	0.684
91	United Twp	0.683
92	Reavis Twp	0.682
93	Thompsonville	0.652
94	Rich Twp	0.579
95	Bremen	0.578
96	Joliet Twp	0.543
97	St Anne HS	0.486
98	Thorton Twp	0.447
99	J S Morton	0.445
100	Bloom Twp	0.437
101	Proviso Twp	0.330

Table 5: Elasticity Estimates

District Type	e_E	e_R	e_X	RTS
USD	-0.0760	0.2072	0.2107	0.3418
ESD	-0.0939	0.0754	0.0746	0.0561
HSD	-0.1972	0.3775	0.1008	0.2812
Average	-0.1224	0.2200	0.1287	0.2264